PEARL CITY SEWAGE PUMP STATION MODIFICATION AND NEW FORCE MAIN SOIL EXPLORATION REPORT

EWA, OAHU, HAWAII
TAX MAP KEY: 9-7-16, 9-6-01, 9-6-03
9-4-08, 9-3-02, 9-1-10

To:
PARK ENGINEERING, INC.

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

MAY 12, 1975

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

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May 12, 1975

PARK ENGINEERING, INC.
Suite 2085, Pacific Trade Center
190 South King Street
Honolulu, Hawaii 96813

Gentlemen:

Subject: Pearl City Sewage Pump Station
Modification and New Force Main
Soil Exploration Report
(for generator building and force
main foundation design purposes)
Ewa, Oahu, Hawaii
Tax Map Key: 9-7-16, 9-6-01, 9-6-03
9-4-08, 9-3-02, 9-1-10

Transmitted herewith is our soil exploration report for foundation design purposes for the Pearl City Sewage Pump Station Modification and New Force Main, Ewa, Oahu, Hawaii.

The discussion and recommendations in this report are presented for design purposes only. In general, the contractor should be allowed to make his own evaluation of soil and construction conditions and select his own methods to install the sewer lines.

This report includes a Boring Location Sketch, boring logs, laboratory test results, general foundation recommendations and limitations.

Respectfully submitted,

WALTER LUM ASSOCIATES, INC.

By Ezra Koike
Ezra Koike

CR/EK:rmf

C O N T E N T S

PEARL CITY SEWAGE PUMP STATION
MODIFICATION AND NEW FORCE MAIN
SOIL EXPLORATION REPORT

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SCOPE OF EXPLORATION

The purpose of this exploration was to evaluate general soil conditions for foundation design considerations for the proposed Pearl City Sewage Pump Station Modification and New Force Main, Ewa, Oahu, Hawaii.

This report includes field explorations, laboratory tests, general foundation design recommendations and limitations.

FIELD EXPLORATION

Fifty-three exploratory borings, and 17 probings were made along the proposed alignment. The approximate locations of the borings and probings are shown on the Boring Location Sketches.

Auger borings were made with 3 and 4-in. diameter augers using finger type and drag bits. Wash borings were made with 2-1/2 and 2-5/8-in. diameter chopping bits.

Soil samples were recovered using 2, 2-1/2 and 3-in. diameter thin-wall tubes and a standard split spoon sampler driven with a 140-lb hammer falling 30 inches. Core samples were recovered using a "BX" wire line core barrel with a diamond coring bit.

Probings were made with a 2-in. diameter blunt point attached to "AW" rods driven with a 140-lb hammer falling 30 inches or pushed down by hand.

Vane shear testing was made with 2-in. tapered and rectangular vanes attached to 1/2-in. diameter rods.

Also attached is a log of a boring made previously near the existing Waipahu Sewage Pump Station.

LABORATORY TESTS

Laboratory tests included: density and natural water content, unconfined compression, laboratory vane shear, Atterberg limit, grain-size analysis, specific gravity, triaxial test, consolidation test, AASHO T-180-73I density and CBR.

A summary of the laboratory test results is given in Tables IA thru IU.

SOIL CLASSIFICATION SYSTEM

Soil samples were visually observed and subjected to appropriate tests in the laboratory. Based on visual observations and laboratory tests, the soil descriptions given on the boring logs are generally made in accordance with the "Unified Soil Classification System."

GENERAL SITE CONDITIONS

A one-story generator building is proposed at the Pearl City Sewage Pump Station.

The proposed force main route extends about 4.5 miles in length. The main begins at the existing Pearl City Sewage Pump Station and proceeds westward to an existing junction box at Waipahu Sewage Pump Station. The main continues southward toward Hanaloa Point of the Waipio Peninsula, crosses West Loch of Pearl Harbor in a southwesterly direction and ends at the west boundary of the West Loch Ammunition Depot.

The route is divided into 3 sections:

Section 2

From the existing Pearl City Sewage Pump Station to the existing Waipahu Sewage Pump Station, about 2.1 miles in length.

Section 1B

From the existing Waipahu Sewage Pump Station to Hanaloa Point, about 1.6 miles in length.

Section 1A

From Hanaloa Point to the west boundary of the West Loch Naval Ammunition Depot, about 0.8 mile in length.

Some general topographic features along the 3 sections may be roughly described as follows:

Section 2

Generator building at Pearl City Pump Station

The proposed building site is located along the west side of the existing Pearl City Pump Station.

An existing dirt road is located on the northern boundary of the site.

The site is about 4 ft lower than the road and is a relatively level area.

The site is presently covered with brush. Some trees are located along the southern boundary.

Force main

The route begins at the existing Pearl City Sewage Pump Station, continues westerly crossing Waiawa Stream, passes along the north edge of the Naval sanitary landfill, passes along the north edge of the wildlife refuge, crosses Waiawa Springs Stream, and passes along the shoreline of the upper reaches of Middle Loch to Waipio Point Access Road. Most of this portion is adjacent and parallel to the existing Navy rights-of-way along which existing overhead and underground utilities are located. The site along this portion of the route includes swamp land, tall grass, brush, trees, the shoreline of Middle Loch and rubbish dumps.

The route continues westerly crossing under Waipio Point Access Road, passes along the northerly boundary of the Ted Makalena Golf Course, crosses a concrete lined drainage channel and extends to the existing Waipahu Sewage Pump Station. The site along this portion of the route includes grassed fairways, roads and brush.

Section 1B

The force main route turns southerly from the Waipahu Sewage Pump Station passing enroute the Waipahu Incinerator Facility, thru sanitary landfill and sugarcane fields to Hanaloa Point. The site along this portion of the route includes A.C. paved and dirt roads, filled areas and sugarcane fields.

Section 1A

From Hanaloa Point, the force main route continues southwesterly underwater across West Loch of Pearl Harbor and emerges at the West Loch Naval Ammunition Depot.

The force main route continues in a southwesterly direction thru the West Loch Ammunition Depot for a distance of about 2,000 ft from the shoreline. The site for the last portion of the route included A.C. paved roads, grassed fields and miscellaneous buildings.

Many existing overhead and underground utility lines are located along the proposed route of the force main.

There is an existing Navy fuel line located near Section 1B, Sta. 73+00.

SOIL AND GEOLOGIC DESCRIPTIONS BY OTHERS

From a review of geologic literature and the U. S. Soil Conservation Service maps of the area, the soils along the project route generally described by others are as follows:

Stearns, H. T. and U. S. Geological Survey, "Geologic and Topographic Map, Island of Oahu," USGS 1938:

Section 2 and 1B of project

Ra, Unconsolidated noncalcareous deposits, chiefly younger alluvium

Pa, Consolidated noncalcareous deposits, chiefly older alluvium

Pls, Consolidated calcareous marine sediments, chiefly emerged coral reefs

Section 1A (land portion) of project

Pls, Consolidated calcareous marine sediments, chiefly emerged coral reef

The soil descriptions by U. S. Soil Conservation Service, "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai and Lanai, State of Hawaii," August 1972 are shown on Figure 2 and are also described below for the various sections of the project:

Section 2 of project

Ph, Pearl Harbor clay

Unified Soil Classification - CH, Pt

WzC, Waipahu silty clay, 6 to 12% slopes

Unified Soil Classification - CL

KlA, Kawaihapai clay loam, 0 to 2% slopes

Unified Soil Classification - CL

KmbA, Keaau clay, saline, 0 to 2% slopes

Unified Soil Classification - CH

Fd, Fill land

Section 1B of project

FL, Fill land, mixed

CR, Coral outcrop

HxA, Honouliuli clay, 0 to 2% slopes

Unified Soil Classification - CL

MnC, Mamala stony silty clay loam, 0 to 12% slopes

Unified Soil Classification - CL-ML

Section 1A (land portion) of project

EmA, Ewa silty clay loam, moderately shallow, 0 to 2% slopes

Unified Soil Classification - ML or CL

INTERPRETATION OF SOIL CONDITIONS

From the field exploration and laboratory test results, the soils encountered in the borings may be generally approximated as follows:

Section 2

Generator building at Pearl City Pump Station

A surface crust of about 8 ft of stiff to medium, brown silty clays (MH) over soft dark gray, organic silts (OH) to about 79 ft, then stiff to medium, brown silty clays (MH) to about 100 ft, the depth drilled.

Silty sand (SM) layers were noted at about 63 and 73-ft depths.

Water was noted in the boring at about 3.5-ft depth at the start of the boring. As the boring reached about the 85-ft depth, water rose in the boring with a head of about 1.5 ft above the ground surface.

From Sta. 0+00 (existing Pearl City Sewage Pump Station) to about Sta. 7+50 (Waiawa Stream), Boring Nos. B-3 to B-6

A surface crust about 3 to 9 ft thick of brown, silty clay (MH) underlain by soft, dark gray organic clays and silts (OH) to about 30 to 35 ft, the depths drilled.

Layers of loose, dark gray or brown, silty sand (SM) were noted scattered within the organic clays and silt layers in Boring Nos. 5 and 6.

Water was noted in the borings at the ground surface to about 4 to 6 ft below the existing ground surface during the field explorations.

About Sta. 7+50 (Waiawa Stream Crossing) to about Sta. 9+00, Boring Nos. B-6 to B-7

Along the east bank: a surface crust about 3 ft thick of soft, brown clayey silt (MH) underlain by soft, dark gray organic silts (OH) to about 23 ft, then loose, dark gray silty sand (SM) to about 30 ft, the depth drilled.

In the stream, the probings indicated: water to about the 6-ft depth, then soft mud to about 9 ft, the depth probed.

Variations to the above soil and ground water conditions are to be expected between borings and in localized areas. For more detailed descriptions of soils encountered in the borings, refer to the boring logs.

DISCUSSION AND RECOMMENDATIONS

A one-story generator building is proposed at the Pearl City Sewage Pump Station.

A new force main about 4.5 miles in length is proposed.

Preliminary plans for the new force main proposes 2 parallel lines (33-in. and 39-in. diameters) between Pearl City and Waipahu Sewage Pump Stations and 2 parallel lines (42-in. and 48-in. diameters) between the Waipahu Sewage Pump Station and the West Loch Ammunition Depot.

The proposed inverts vary from 5 to 15-ft depths below the existing ground surface for most of the proposed force main route. Portions of the lines will be above water and portions below water. Deeper depths to invert, about 20 to 35 ft, are contemplated where the route crosses beneath stream beds, road crossings, drainage structures and navigable water.

Because of the varied ground conditions anticipated along the proposed route, maintaining alignment may be a problem in some areas and future maintenance work may be needed. Depending on the thickness of the soft or loose materials underlying the pipe and construction methods used by the contractor, settlements of a few inches to a foot or more may occur.

Existing underground and overhead utilities are located in the vicinity of or cross the proposed alignment. The contractor should refer to the plans for utilities and should proceed with caution wherever utilities are suspected.

At the Pearl City Sewage Pump Station and Waipahu Sewage Pump Station, the force mains would connect to existing structures that are supported on pile foundations. Differential settlements that would occur between the pile supported and non-pile supported sections of the pipes should be considered in the design of the lines in these areas.

Sewer lines should be constructed with flexible joints, particularly where the lines are connected to junction boxes, structures and concrete jackets.

If grading work, particularly fill construction, is contemplated over soft areas along the force main route, the fills should be placed as soon as practicable. This is to allow time for the ground to consolidate and settle prior to the start of pipeline construction. Preferably, a surcharge should be placed over the soft areas along the force main easement prior to installation of the lines.

A general discussion of the soil features and force main foundation design considerations along the proposed route has been broken down by various sections for this report.

Generator Building at Pearl City Pump Station

The present plan is to construct a one-story generator building, about 44 by 55 ft in plan.

Fills of about 1 to 6 ft are planned for site development.

To reduce the effects of settlements, site grading should be done as soon as practicable to allow some time for the underlying soils to consolidate, settle and adjust to the new load conditions before constructing the structure on grade. The fill should be constructed in thin lifts compacted to 90% of AASHO T-180-73I density.

The site should generally be designed and graded to prevent ponding of water and to provide positive drainage away from the building even after some areal settlements occur.

The generator building will connect up with an existing pump station on pile foundations. To lessen differential settlement effects between the two buildings, pile foundations are recommended for the new structure.

Foundations

For the generator building, piles extending into the silty sand layer at about the 65-ft depth may be considered. The driving of longer piles may penetrate a water bearing stratum with an artesian head. Should an artesian water flow occur

during pile driving, the flow should be stopped by grouting or any other method acceptable to the appropriate government agencies.

Pile foundations would usually minimize or reduce settlements. However, even with a pile foundation, some differential settlements may occur due to differences in building loads and variations underlying the pile tips.

Also, some differential movements between the pile supported and non-pile supported structures should be anticipated.

Existing buildings and underground utilities are located in adjacent properties around the site. Predrilling thru the surface layers should be considered to minimize settlements and damages to these buildings and utilities resulting from pile driving.

For pile foundations, the following may be used as a guide:

1. The piles should be driven with a hammer delivering about 15,000 ft-lbs of energy. The piles should be set into the bearing stratum to about 25 blows per foot for 10 ft, but not to be overdriven to more than 10 blows for the last fraction of an inch.

2. The estimated depths of pile penetration may be in the order of about 75 ft or more below the present surface. Test piles should be driven to determine the order lengths to be used for this project. The same type of hammer should be used for production driving as used for the test piles.

3. The piles should be placed as far apart as practicable and generally not less than 3 ft on centers.

4. Due to the long estimated pile lengths, 12-in. by 12-in. or 16-1/2 by 16-1/2-in. prestressed concrete piles are recommended. Allowable bearing values of 25 tons per pile are recommended for piles driven to the above guidelines. Low allowable pile values are recommended because of the erratic bearing stratum, possible bending due to earthquake loads and dragdown forces on the piles. Theoretically, 10-in. by 10-in. prestressed concrete piles may be used. However, this size of pile tends to break because of the long lengths, rough handling and driving conditions and larger piles are preferred.

5. Splicing of piles should be avoided, if practicable.

6. The pile driving contractor should observe that piles already in place are not heaved upward during pile driving. A pile that has been heaved upward should be redriven to its original position.

   To check that piles have not been heaved upward by the driving of adjacent piles, each pile should be tapped or redriven after all the piles in the cluster have been driven.

7. Foundations should be well tied together with deep grade beams, particularly around the perimeter of the structures.

Floor slab

Since differential settlements between the pile supported and non-pile supported structures are anticipated, the ground floor should be a structural system.

Concrete slabs on ground

To lessen the capillary rise of water from underlying soils, concrete slabs on ground should be placed over a base course

of 4 in. of well-graded gravel less than 3/4-in. and greater than 1/4-in. in size or some other form of capillary break should be provided.

If soft pockets or expansive soil pockets are encountered, they should be removed to a depth of 2 ft below the bottom of the slab and replaced with fairly well-graded granular material.

The subgrade should be compacted and shaped to a level surface or to drain, if practicable.

Joint and connection details

Some differential settlements are to be expected between the building elements. Joints and connections should be detailed to allow some movements.

Sidewalks, entry slabs and ramps to the building should be supported on hinged seats that would permit some rotation and maintain a smooth transition to the building.

Subbase for New Force Main

In general, soft soils below the inverts of the pipes should be removed and replaced with granular material subbase.

The subbase thickness should be adjusted according to the type of soil below the inverts.

PEARL CITY SPS

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

PEARL CITY SPS MODIFICATION

Boring Log

PROJECT: PEARL CITY SEWAGE PUMP STATION MODIFICATION AND NEW FORCE MAIN

LOCATION: Ewa, Oahu, Hawaii

HAMMER: Weight 140# Drop 30"

SAMPLER: 2" SS - 2" STANDARD SPLIT SPOON; 3" S - 3" O.D. THIN WALL TUBE

BORING NO. 1 Sheet No. ____ of ____

Driller W. LUM ASSOC., INC Date Nov. 6-15, 1974

Field Party MEYER, SEAWELL, OSHIRO, KAKU, ASATO, ORITA & KAU

Type of Boring AUGER (MOBILE B-40) Diam. 4"

Elev. 6'± Datum —

Drill Bit T.C. DRAG

Water Level	3.5'	+1.5'			
Time	—	9:00 AM			
Date	11-6-74	11-15-74			

Unified Soil Classification	DESCRIPTION	Depth (Ft.)	Sampler	Sample No.	Plastic Limit	Water Cont. %	Liquid Limit	Unconf. Comp. P.S.F.	Vane Shear P.S.F.	PENETRATION DATA: Standard Penetration Test N (Blows per foot) 0 10 20 30 40	PENETRATION DATA: 3" O.D. THIN WALL TUBE SAMPLER BLOWS/0.5'
	ELEV. = 6'±	0	WATER 11-15-74 1.5'								
(MH)	STIFF, BROWN SILTY CLAY W/SOME DECOMPOSED ROCK		2"SS	1-A	-	33	-	-	-		
			WATER 11-6-74								
(MH)	MEDIUM, BROWN SILTY CLAY W/TRACES OF SAND	5	2"SS	1-B	-	92	-	-	-		
		10	2"SS	1-C	-	90	-	-	-	1/1.5'	
		15	3"S	1-D	43	90 78	84	-	-		2/0.5' 2/0.5' 2/0.5'
OH	SOFT, DARK GRAY ORGANIC SILTY CLAY W/TRACES OF SAND & SHELLS	20	2"SS	1-E	65	79	171	-	-	1/1.5'	
		25	3"S	1-F	-	74 γ_w = 91 γ_D = 52	-	-	160 180 200		2/0.5' 2/0.5' 2/0.5'
		30	2"SS	1-G	-	78	-	-	-	2/1.0'	
OH	SOFT, DARK GRAY ORGANIC SILT	35	2"SS	1-H	41	74	72	-	-	1/1.5'	
		40	2"SS	1-I	-	76	-	-	-	1/1.5'	
		45									
(OH)	SOFT, DARK GRAY ORGANIC SILT W/TRACES OF SHELLS	50	2"SS	1-J	-	80	-	-	-	1/1.5'	
		55	2"SS	1-K	-	80	-	-	-	2/1.0'	
		60	2"SS	1-L	-	85	-	-	-	1 MAN PUSH/1.5'	
(SM)	LOOSE, DARK GRAY SILTY SAND	65	2"SS	1-M	-	67	-	-	-	2/1.0'	
OH	SOFT, DARK GRAY ORGANIC SILT W/TRACES OF SAND	70	2"SS	1-N	61	65	90	-	-	2/1.0'	

	ORGANIC SILT											
		40	2"SS	1-I	-	76	-	-	-	1/1.5'		
		45										
(OH)	SOFT, DARK GRAY ORGANIC SILT W/TRACES OF SHELLS	50	2"SS	1-J	-	80	-	-	-	1/1.5'		
		55	2"SS	1-K	-	80	-	-	-	2/1.0'		
		60	2"SS	1-L	-	85	-	-	-	1 MAN PUSH/1.5'		
(SM)	LOOSE, DARK GRAY SILTY SAND	65	2"SS	1-M	-	67	-	-	-	2/1.0'		
OH	SOFT, DARK GRAY ORGANIC SILT W/TRACES OF SAND	70	2"SS	1-N	61	65	90	-	-	2/1.0'		
(SM)	MEDIUM DENSITY DARK BROWN SILTY SAND	75	2"SS	1-O	-	44	-	-	-			
(MH)	STIFF, DARK BROWN & GRAY SILTY CLAY W/TRACES OF SAND (SLIGHTLY CLAY)	80	2"SS	1-P	-	48	-	-	-			
		85	2"SS	1-Q	NO	RECOVERY		-		15/0.5'	15/0.0'	
	COBBLE OR BOULDER?											
	NOTE: AT 85' ± DEPTH, WATER LEVEL ROSE TO 1.5' ± ABOVE GROUND SURFACE											
MH	STIFF TO MEDIUM BROWN, SILTY CLAY W/TRACES OF DECOMPOSED ROCK	90	2"SS	1-R	34	45	60	-	-			
		95	2"SS	1-S	-	41	-	-	-			
(MH)	STIFF, BROWN SILTY CLAY W/GRAVEL	100	2"SS	1-T	-	47	-	-	-			
	END OF BORING @ 101.5 11-15-74											
	* ELEVATION ESTIMATED FROM TOPO MAP BY PARK ENGINEERING, INC.				NOTE: γ_w = WET γ_d = DRY		DENSITY: PCF		C.F.: C.I.			

PEARL CITY SPS

WALTER LUM ASSOCIATES, INC. 3030 WAIALAE AVENUE • HONOLULU, HAWAII 96816 • PHONE 737-7931

Boring Log

PROJECT: PEARL CITY SEWAGE PUMP STATION MODIFICATION AND NEW FORCE MAIN

LOCATION: Ewa, Oahu, Hawaii

HAMMER:
Weight: 140#
Drop: 30"

SAMPLER: 2" DIAM. BLUNT POINT

PROBING 2 — PEARL CITY SPS MODIFICATION
~~BORING~~ NO. 2 Sheet No. ____ of ____
Driller: W. LUM ASSOC., INC. Date: JAN. 23, 1975
Field Party: SHIROMA, ORITA
Type of Boring: CONTINUOUS PENETRATION Diam.: 2"
Elev.: 5'± Datum: —
Drill Bit: —

Water Level	+5.0'	+3.0'			
Time	3:00 PM	10:00 AM			
Date	1-23-75	1-24-75			

PENETRATION DATA
~~Standard~~ CONTINUOUS Penetration Test
N (Blows per foot) 0 10 20 30 40

Unified Soil Classification | DESCRIPTION | WATER HEAD** 1-23-75 | Depth (Ft.) | Sampler | Sample No. | Plastic Limit | Water Cont. % | Liquid Limit | Unconf. Comp. P.S.F. | Vane Shear P.S.F.

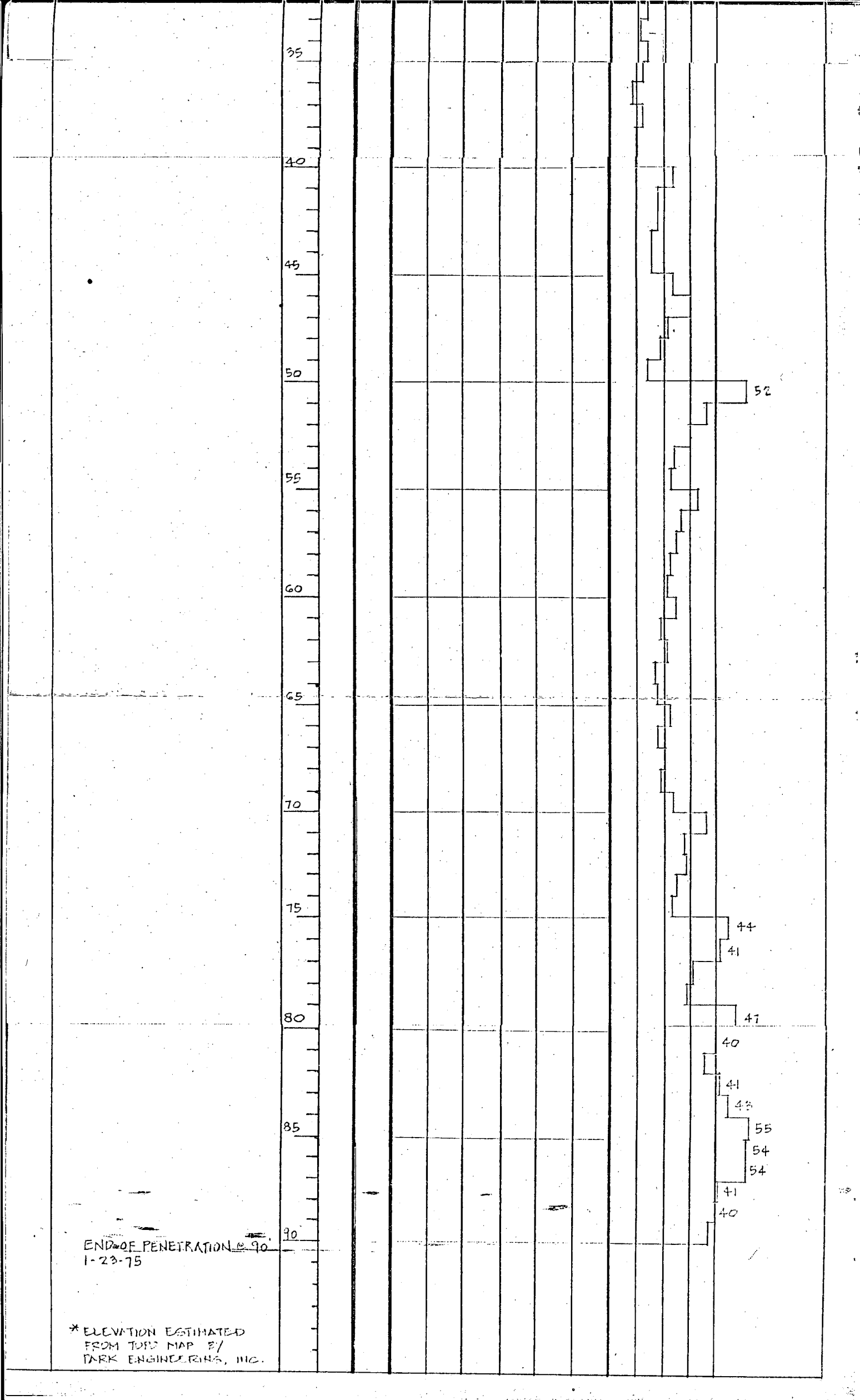
EXIST. GRND. ELEV. = 5'± *

** WATER FLOWED FROM HOLE AFTER PULLING OUT PROBING RODS.

WATER LEVEL MEASURED IN 2" ϕ PIPE PLACED IN PROBING HOLE.

0 5 10 15 20 25 30 35 40 45 50 55 60

52



END OF PENETRATION @ 90
1-23-75

*ELEVATION ESTIMATED FROM TOPO MAP BY DARK ENGINEERING, INC.

PEARL CITY SEWAGE PUMP STATION
MODIFICATION & NEW FORCE MAIN

TABLE I A - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	1	1	1	1
SAMPLE NO.		D	E	H
DEPTH BELOW SURFACE	SURFACE	15.5'-16.5'	20'-21.5'	35'-36.5'
DESCRIPTION	BROWN SILTY GRAVEL W/SAND	DARK GRAY ORGANIC SILTY CLAY W/TRACES OF SAND & SHELLS	DARK GRAY ORGANIC SILTY CLAY W/TRACES OF SAND & SHELLS	DARK GRAY ORGANIC SILT
GRAIN-SIZE ANALYSIS (% Passing) Sieve				
1"	93.4			
1/2"	77.7			
#4	68.1			
#10	62.4			
#20	57.2			
#40	52.3			
#100	45.2			
#200	42.5			
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	63	84	171	72
Plastic Limit	33	43	65	41
Plasticity Index	30	41	106	31
Dilatancy	MEDIUM	MED-QUICK	MED-QUICK	QUICK
Toughness	MEDIUM	MEDIUM	MEDIUM	MED.-SLIGHT
Dry Strength	MEDIUM	MEDIUM	MEDIUM	MEDIUM
UNIFIED SOIL CLASSIFICATION	GM	OH	OH	OH
APPARENT SPECIFIC GRAVITY		2.89		
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %	25.5			
Molding Dry Density, P.C.F.	96.5			
Swell upon saturation, %	1.1			
CBR at 0.1" Penetration	14.5			
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method ___)	A			
Dry to Wet or Wet to Dry	DRY TO WET			
Max. Dry Density (P.C.F.)	96			
Optimum Moisture (%)	26			

REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 2-28-75 By BT

3-1273

PEARL CITY SEWAGE PUMP STATION
MODIFICATION & FORCE MAIN

TABLE I 5 - SUMMARY OF LABORATORY TEST RESULTS

BORING NO.	1	1	5	5
SAMPLE NO.	N	R	C	E (TOP)
DEPTH BELOW SURFACE	70'-71.5'	90-91.5'	10'-11.5'	20'-21.5'
DESCRIPTION	DARK GRAY ORGANIC SILT W/TRACES OF SAND	BROWN SILTY CLAY W/TRACES OF DECOMP. ROCK	GRAY ORGANIC CLAYS & SILTS	BROWN & BLACK SILTY SAND
GRAIN-SIZE ANALYSIS (% Passing) Sieve				
1"				100
1/2"				100
#4				96.2
#10				90.9
#20				76.2
#40				58.7
#100				43.5
#200				38.9
ATTERBERG LIMITS				
Air Dried or Natural	NATURAL	NATURAL	NATURAL	NATURAL
Liquid Limit	90	68	72	5'-
Plastic Limit	61	34	38	33
Plasticity Index	29	34	34	18
Dilatancy	MED.-QUICK	MEDIUM	QUICK	MED.-QUICK
Toughness	MEDIUM	MEDIUM	MEDIUM	MEDIUM
Dry Strength	MEDIUM	MEDIUM	MEDIUM	MEDIUM
UNIFIED SOIL CLASSIFICATION	OH	MH	OH	SM
APPARENT SPECIFIC GRAVITY				
CBR TEST (Surcharge-51 P.S.F.)				
Molding Moisture, %				
Molding Dry Density, P.C.F.				
Swell upon saturation, %				
CBR at 0.1" Penetration				
MOISTURE-DENSITY RELATIONS OF SOILS (AASHO T-180-73I, Method ___)				
Dry to Wet or Wet to Dry				
Max. Dry Density (P.C.F.)				
Optimum Moisture (%)				

REMARKS:

WALTER LUM ASSOCIATES, INC.
CIVIL, STRUCTURAL, SOILS ENGINEERS

Date 2-28-75 By BT

3-1273